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Base Background Groundwater Study  
Phase II  
Confirmatory Sampling Investigation  
Quality Assurance/Project Plan (QAPP)

Marine Corps Base  
Camp Lejeune, North Carolina



Prepared For  
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## ACRONYMS AND ABBREVIATIONS

AA	Atomic Absorption
ASTM	American Society for Testing and Materials
Baker	Baker Environmental, Inc.
BFB	p-bromofluorobenzene
CCC	Calibration Check Compound
CLEAN	Comprehensive Long-term Environmental Action Navy
CLP	Contract Laboratory Program
CMI	Corrective Measures Implementation
COC	Chain-of-Custody
CRDL	Contract Required Detection Limit
CTO	Contract Task Order
DFTPP	decafluorotriphenylphosphine
DQOs	Data Quality Objectives
DoN	Department of Navy
GC/MS	Gas Chromatograph/Mass Spectroscopy
ICP	Inductively Coupled Plasma
IDW	Investigation Derived Waste
LANTDIV	DoN, Atlantic Division
MCB	Marine Corps Base
MDL	Method Detection Limit
NCRs	NFESC Contract Representatives
NFESC	Naval Facilities Engineering Service Center
ng	Nanograms
NTR	Navy Technical Representative
PCBs	Polychlorinated biphenyls
PEMs	Performance Evaluation Mixtures
PID	Photo Ionization Detection
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
RFI	RCRA Facility Investigation
RCRA	Resource Conservation and Recovery Act
RPD	Relative Percent Difference
RRF	Relative Response Factor
SOP	Standard Operating Procedure
SWMU	Solid Waste Management Unit

**ACRONYMS AND ABBREVIATIONS**  
**(Continued)**

the Base	Marine Corps Base, Camp Lejeune, North Carolina
USEPA	U.S. Environmental Protection Agency
VOCs	Volatile Organic Compounds

## 1.0 INTRODUCTION

This Quality Assurance Project Plan (QAPP) has been developed for the Phase II Solid Waste Management Unit (SWMU) Confirmatory Sampling and the Background Groundwater Study at the Marine Corps Base (MCB), Camp Lejeune, North Carolina.

The preparation of this QAPP and other related project plans, is being performed under the Navy Comprehensive Long-term Environmental Action Navy (CLEAN) Contract No. N62470-95-D-6007, Contract Task Order (CTO) 0143. Baker Environmental, Inc. (Baker) is subcontracted to CH2MHill for implementation of this project.

This QAPP addresses the quality assurance/quality control (QA/QC) steps and procedures that will be implemented for sample collection and analysis. Detailed information regarding sample handling and analytical methods are provided in Sections 6.0 and 9.0, respectively. Sample collection procedures are provided in the Work Plans.

The structure of this QAPP and the QA elements addressed are as follows:

- QAPP Scope
- Project Description
- Project Organization
- QA Objectives for Data Measurement
- Sampling Procedures
- Sample and Document Custody
- Calibration Procedures and Frequency
- Analytical Procedures
- Data Reduction, Validation, and Reporting
- Internal QC Checks
- Performance and System Audits
- Preventive Maintenance
- Data Measurement Assessment Procedures
- Corrective Action
- QA Reports to Management

## **2.0 SCOPE OF QUALITY ASSURANCE PROJECT PLAN**

This QAPP addresses sample collection and analysis to be conducted for the Phase II SWMU Confirmatory Sampling and Background Groundwater Study at the Base. The QAPP has been developed for the Department of Navy (DoN) in accordance with U.S. Environmental Protection Agency (USEPA) guidelines. Contractors will follow QA/QC practices and procedures specified in the QAPP while conducting sample collection and analysis activities.

In order to provide adequate QA/QC, these investigations will require the following:

1. The use of a Naval Facilities Engineering Service Center (NFESC)-certified analytical laboratory
2. The use of accepted analytical methods for the samples discussed in the Work Plans. Analysis of samples for hazardous constituent parameters will be performed in accordance with the following documents:
  - "Statement of Work for Organic Analysis," USEPA, OLM04.2, May 1999
  - "Statement of Work for Inorganic Analysis," USEPA, ILM04.1, 1990
  - "Methods for Chemical Analysis of Water and Waste," USEPA, 1979, Revised March 1983
  - "Environmental Protection Agency Regulations on Test Procedures for Analysis of Pollutants," USEPA, 40 CFR 136
  - "Test Methods for Evaluating Solid Waste," USEPA SW846, 3rd Edition 1997
  - "Hazardous Waste Management System; Identification and Listing of Hazardous Waste; Toxicity Characteristics Revisions; Final Rule," USEPA, 52 FR 26886

### **3.0 PROJECT DESCRIPTION**

Introductions describing the project objectives and scope for the Phase II SWMU Confirmatory Sampling and Background Groundwater Study are provided in Sections 1.0 and 4.0 of the Work Plans, respectively. Detailed descriptions of the field investigations, including sample locations and frequency, sample designations, and sampling procedures are presented in Sections 4.0, 5.0, and 6.0 of the Work Plans.

#### **4.0 PROJECT ORGANIZATION**

Technical performance and key personnel responsible for quality assurance throughout the duration of the projects are described in Section 9.0 of the Work Plans. Subcontractors will be used to perform laboratory analysis, data validation, drilling, and monitoring well installation. Specific subcontractors have not yet been identified. Figure 4-1 shows the project organization, lines of authority, and support personnel/organizations.

## 5.0 QUALITY ASSURANCE OBJECTIVES FOR DATA MEASUREMENT

The purpose of a QA Program is to establish policies for implementation of regulatory requirements and to provide an internal means for control and review so that the work performed is of the highest professional standards.

### 5.1 Project Quality Assurance Objectives

The following is a list of QA objectives that will be implemented:

- Obtain scientific data of a quality sufficient to meet scientific and legal scrutiny.
- Gather/develop data in accordance with procedures appropriate for its intended use.
- Ensure that data is of acceptable precision, accuracy, completeness, representativeness, and comparability as required by the project.

The fundamental mechanisms that will be employed to achieve these quality goals can be categorized as prevention, assessment, and correction where:

- Prevention of errors through planning, documented instructions and procedures, and careful selection and training of skilled, qualified personnel.
- Assessment of all quality assurance sampling reports furnished by the contract laboratory.
- Assessment of data through data validation, and of procedures through laboratory and field audits.
- Correction for prevention of reoccurrence of conditions adverse to quality.

This QAPP, prepared in direct response to these goals, describes the QA Program to be implemented and the QC procedures to be followed by field and laboratory personnel during the course of the project.

This QAPP presents the project organization and specifies or references technical procedures, documentation requirements, sample custody requirements, audit, and corrective action provisions to be applied to provide confidence that all activities meet the intent of the QA program. This QAPP has been prepared in accordance with USEPA guidance as presented in "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans," QAMS-005/80.

The procedures contained or referred to herein have been taken from:

- "Statement of Work for Organic Analysis," USEPA, OLM04.2, May 1999
- "Statement of Work for Inorganic Analysis," USEPA, ILM04.1, 1990
- "Methods for Chemical Analysis of Water and Waste," USEPA, 1979, Revised March 1983
- "Environmental Protection Agency Regulations on Test Procedures for Analysis of Pollutants," USEPA, 40 CFR 136

- "Test Methods for Evaluating Solid Waste," USEPA SW846, 3rd Edition, 1997
- "Hazardous Waste Management System; Identification and Listing of Hazardous Waste; Toxicity Characteristics Revisions; Final Rule," USEPA, 52 FR 26886
- "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans," USEPA, (QAMS 005/80).

## **5.2 Data Quality Objectives**

Data quality objectives (DQOs) are qualitative or quantitative statements developed by the data users to specify the quality of data needed from a particular data collection activity to support a specific decision. The DQOs are expressed in terms of precision, accuracy, representativeness, completeness, and comparability. Definitions for these terms, as well as for the more general term uncertainty, are provided in Table 5-1. Detailed discussions of the DQOs for the Phase II SWMU Confirmatory Sampling and the Background Groundwater Study are presented in Section 3.0 of the Work Plans.

The intended use of the data, analytical measurements, and the availability of resources are integral in development of DQOs. DQOs define the level of uncertainty in the data that is acceptable for each specific activity during the investigations. This uncertainty includes both field sampling error and analytical instrument error. Ideally, zero uncertainty is the goal; however, the variables associated with sampling and analysis contribute to a degree of uncertainty in any data generated. It is an overall program objective to keep the total uncertainty within an acceptable range, so as not to hinder the intended use of the data. To achieve this objective, specific data quality requirements such as detection limits, criteria for accuracy and precision, sample representativeness, data comparability, and data completeness have been specified.

The data collected during the Phase II SWMU Confirmatory Sampling will be used to further characterize soil and groundwater in the vicinity of selected SWMUs and determine if additional action is warranted in the form of Resource Conservation and Recovery Act (RCRA) Facility Assessments (RFIs) or Corrective Measures Implementations (CMIs).

The data collected during the Background Groundwater Study will be used to develop a statistical base for evaluating results from future investigations at the Base. Specifically, the data will be used to assess whether inorganics detected in samples collected during future investigations are attributable to activities at the Base, are naturally occurring, or are of anthropogenic origin.

All soil and groundwater samples will be analyzed and reported by the laboratory as Level IV data (NFESC Level D). Level IV was selected to provide the highest level of confidence in data quality. All Investigation Derived Waste (IDW) samples will be analyzed and reported by the laboratory as Level III data (NFESC Level C). Field parameters, including temperature, pH, specific conductance, dissolved oxygen, turbidity, and oxidation/reduction potential will be Level I (NFESC Level A) data quality.

## **6.0 SAMPLE AND DOCUMENT CUSTODY PROCEDURES**

Sample custody procedures outlined in this section have been developed from "User's Guide to the Contract Laboratory Program," December 1988, OSWER Directive No. 9240.0-01. These procedures are in accordance with "EPA NEIC Policies and Procedure Manual," May 1978, revised November 1984, EPA 330-78-001-R and "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans," December 1980, QAMS-005/80.

The purpose of this section is to outline the sample handling and sample documentation procedures to be used during implementation of the Work Plans. The objective of the sample handling procedures is to deliver representative samples to the laboratory for analysis. The objectives of the sample documentation procedures are as follows:

- Ensure complete analysis of the requested parameters within the required turnaround times
- Document the sample from the point of collection to the final data report.

Descriptions of the procedures to be used for soil and groundwater sampling are provided in Section 6.0 of the Work Plans. The number of samples, sampling locations, and sampling rationale by media are presented in Section 4.0 of the Work Plans.

### **6.1 Sampling Handling**

The laboratory will provide appropriate sample containers with the proper preservatives for sample collection. In addition to the chemical preservatives, samples will be stored on ice at approximately 4 degrees Celsius (or less) in a waterproof metal or sturdy plastic cooler, if required. Tables 6-1 and 6-2 provide summaries of containers, preservation, and holding times for water and solids, respectively.

### **6.2 Chain-of-Custody Procedures**

#### **6.2.1 Field Chain-of-Custody Procedures**

A sample is considered to be in an individual's possession if:

- It is in the sampler's possession or it is in the sampler's view after being in his or her possession.
- It was in the sampler's possession and then locked or sealed to prevent tampering.
- It is in a secure area.

Five kinds of documentation will be used in tracking and shipping the analytical samples as follows:

- Field log book
- Sample labels
- COC records
- Custody seals
- Commercial carrier airbills

At a minimum, the label for each sample bottle will contain the following information:

- Site name
- Sample number
- Date and time of collection
- Sample type (grab or composite)
- Matrix
- Sampler's initials

The sample information, as well as the analysis to be performed on the sample, will be entered in the field logbook for each sampling point. Additionally, the following items will be entered as appropriate:

- Dates and times of entry
- Names of field personnel on site
- Names of visitors on site
- Field conditions
- Description of activities
- Sampling remarks and observations
- QA/QC samples collected
- List of photographs taken
- Sketch of site conditions

Custody of the samples will be maintained by field personnel from the time of sampling until the time they are forwarded to the analytical laboratory.

The sample custody is documented using COC records. Field personnel will complete a COC record in waterproof ink to accompany each cooler forwarded from the site to the laboratory. Chemical reagents used to preserve the samples will be recorded on the COC record. Any errors on the COC records will not be erased; instead, a line will be drawn through the error and initialed by the person completing the form. The original copy will be placed in a sealable plastic bag and put inside the appropriate cooler, secured to the cooler lid.

If the sample cooler is to be shipped by commercial air carrier, the cooler must be secured with custody seals so that the seals would be broken if the cooler was opened. The commercial carrier is not required to sign the COC record as long as the custody seals remain intact and the COC record stays in the cooler. The only other documentation required is the completed airbill.

If the sample shipment is hand delivered to the laboratory by field personnel or retrieved by laboratory personnel at the site, then the custody seals are not necessary. The laboratory sample custodian, or his/her designee accepting the sample shipment, whether it is from the air carrier or the field personnel, will sign and date the COC record upon sample receipt. The original COC record will be returned along with the final data report. The laboratory will be responsible for maintaining internal logbooks and records that provide a custody record during sample preparation and analysis.

### **6.2.2 Laboratory Chain-of-Custody Procedures**

Upon sample receipt, the following steps below will be performed:

- Samples will be received and unpacked in the laboratory where the staff checks for bottle integrity (loose caps, broken bottles, etc.).
- Samples will be verified with incoming paperwork (COC, etc.) by type of bottle and stabilizer. The paperwork must be either signed or initialed.
- Information concerning the sample (from the sampling record, COC, and observation) will be recorded along with parameters to be analyzed, date of sampling, and date the sample is received in the laboratory.
- Samples will be placed in an appropriate secured storage area until analysis.
- When analysis is complete, samples will be stored for a 30-day period unless otherwise specified.

If collected samples arrive without COC or incorrect COC records, the following steps will be taken:

- The laboratory will prepare a nonconformance form stating the problem.
- The Site Supervisor and Project Manager will be notified.
- If the field staff cannot provide the missing information, the affected samples will not be analyzed.

Primary considerations for sample storage are as follows:

- Secured storage.
- Maintain prescribed temperature, if required, which is typically four degrees Celsius.
- Extract and/or analyze samples within the prescribed holding time for the parameters of interest.

### **6.3 Document Custody Procedures**

Project records are necessary to support the validity of the work and to furnish documentary evidence of quality. The evidentiary value of data is dependent upon the proper maintenance and retrieval of quality assurance records. Therefore, procedures will be established to assure that all documents attesting to the validity of work can be accounted for when the work is completed.

Records must be legible, filled out completely, and adequately identified as to the item or activity involved. Records will be considered valid only if initialed, signed, or otherwise authenticated and dated by authorized personnel. These records may either be originals or reproduced copies. Records submitted to the files, with the exception of correspondence, will be bound, placed in folders or binders, or otherwise secured for filing.

Following receipt of information from external sources, completion of analyses, and issuance of reports or other transmittals, associated records will be submitted to the proper file. In addition, transmitted records must be adequately protected from damage and loss during transfer (e.g, hand carrying or making copies prior to shipment).

The following documents will be transferred to the proper files during the course of the project: calculations and check prints; reports and other data transmittals; copies of proposals, purchase orders for project services, and contracts; correspondence including incoming and outgoing letters, memoranda, e-mails, and telephone records; and reference material.

All individuals on the project staff will be responsible for reporting obsolete or superseded project-related information to the Project Manager. In turn, the Project Manager will notify the project and laboratory staffs of the resulting status change in project documents, such as drawings and project procedures.

In general, outdated drawings and other documents will be marked "void." However, the Project Manager may request the copies be destroyed. One copy of void documents is maintained in the project files with the reasons, and date of voiding clearly indicated.

Documents will be marked "preliminary" to denote calculations and other material which have not been formally checked, or based on information which has not been checked, or do not contribute to final project information.

## **7.0 CALIBRATION PROCEDURES AND FREQUENCY**

The subsections that follow describe calibration procedures and frequency.

### **7.1 Field Instruments**

An HNu System portable Photo Ionization Detector (PID) and a Bacharach O<sub>2</sub>/LEL Meter will be used for health and safety monitoring. These instruments will be calibrated on site daily according to the manufacturer's instructions. In addition a factory calibration will be performed prior to the start of site sampling. The calibration standards will be recorded in the field logbook.

A multi-parameter meter will be used to analyze groundwater samples. Multi-parameter meters are capable of measuring temperature, pH, Eh, specific conductance, and turbidity. Manufacturer written calibration methodology will be followed. Specific procedures for the calibration of water quality instruments are presented in the Work Plans.

### **7.2 Laboratory Instruments**

The laboratory's procedures for calibration and related quality control measures will be conducted according to the protocols presented in the following documents:

- "Statement of Work for Organic Analysis," USEPA, OLM04.2, May 1999
- "Statement of Work for Inorganic Analysis," USEPA, ILM04.1, 1990
- "Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater", USEPA, July 1982
- "Methods for Chemical Analysis of Water and Waste," USEPA, 1979, Revised March 1983
- "Environmental Protection Agency Regulations on Test Procedures for Analysis of Pollutants," USEPA, 40 CFR 136
- "Test Methods for Evaluating Solid Waste," USEPA SW846, 3rd Edition 1997
- "Hazardous Waste Management System; Identification and Listing of Hazardous Waste; Toxicity Characteristics Revisions; Final Rule," USEPA, 52 FR 26886

Formal calibration procedures will be established to ensure that instrumentation and equipment used for sample analysis are accurately calibrated and properly functioning. These procedures will apply to all instruments and equipment quantities. All calibrations will be performed by laboratory personnel or external agencies using standard reference materials.

All calibrations will be recorded on in-house calibration forms or instrument vendor forms or in dedicated bound notebooks. The following data will be recorded for all calibrations: the date, target readings, actual readings, instrument identification number, and the analyst's initials. Other data may be recorded depending upon the calibration performed.

Only properly calibrated and operating equipment and instrumentation will be used. Equipment and instrumentation not meeting the specified calibration criteria will be segregated from active equipment whenever possible. Such equipment will be repaired and recalibrated before reuse.

All equipment will be uniquely identified, either by serial number or internal calibration number, to allow traceability between equipment and calibration records. Recognized procedures (ASTM, USEPA, or manufacturer's procedures) will be used for calibration whenever available.

### **7.2.1 Method Calibration**

Method calibration will be performed as part of the laboratory analytical procedure (calibration curves, tuning). Calibration curves will be prepared using five standards in graduated amounts across the appropriate range of analysis. New calibration curves will be prepared whenever new reagents or standards are prepared or yearly, whichever is more frequent.

### **7.2.2 GC/MS System Calibration Procedure**

This section outlines the requirements for the calibration of gas chromatograph/mass spectroscopy (GC/MS) systems for the determination of organic compounds. The following operations will be performed in support of these requirements:

- Documentation of GC/MS mass calibration and abundance pattern
- Documentation of GC/MS response factor stability
- Internal standard response and retention time monitoring

#### Tuning and Mass Calibration

It will be necessary to establish that a given GC/MS system meets the standard mass spectral abundance criteria prior to initiating data collection. This will be accomplished through the analysis of p-bromofluorobenzene (BFB) for volatile compounds or decafluorotriphenylphosphine (DFTPP) for semivolatile compounds. The BFB or DFTPP criteria must be met before any blanks, standards, or samples are analyzed.

A GC/MS system used for organic compound analysis will be tuned to meet the criteria specified for BFB analysis (volatile compounds) or DFTPP (semivolatile compounds) for an injection of 50 nanograms (ng) of BFB or DFTPP. The analysis must be performed separately from standard or blank analysis. These criteria will be demonstrated every 12 hours of operation. Professional judgment must be used to determine whether background subtraction is required to eliminate column bleed or instrument background (i.e., noise). Calibration documentation will be in the form of a bar graph spectrum and a mass listing.

#### GC/MS System Calibration

After tuning criteria have been met and prior to sample analysis, the GC/MS system is initially calibrated at five concentrations utilizing the compounds to be analyzed to determine the linearity of response. Internal and surrogate standards will be used with each calibration standard. Standards will be analyzed under the same conditions as the samples.

- Relative Response Factor (RRF) Calculation - The USEPA specifies the internal standard to be used on a compound-by-compound basis for quantification. The RRF will be calculated for each compound at each concentration level.
- Continuing Calibration - A calibration check standard containing all semivolatile or volatile compounds and surrogates will be run every 12 hours of analysis. A system performance check will also be performed. The criteria will be the same as the initial calibration system

performance check. A calibration check will also be performed. The percent difference will be determined for each Calibration Check Compound (CCC).

The percent Difference for each CCC must be less than or equal to 25.0 percent. The system performance check and calibration check criteria must be met before sample analysis can be performed. The continuing calibration will be recorded on the continuing calibration forms.

#### **7.2.3 GC System Calibration Procedure for Pesticides/Polychlorinated Biphenyls (PCBs)**

This section outlines the requirements for the calibration of GC systems for the determination of pesticides/PCBs. The following operations are performed in support of these requirements:

Three types of analyses will be used to verify the calibration and evaluate instrument performance. The analyses of instrument blanks, Performance Evaluation Mixtures (PEMs), and the mid-point concentration of the individual standard mixtures A and B constitute the continuing calibration.

For pesticide/PCB analysis it is necessary to establish resolution criteria by performing a Resolution Check Mixture where the depth of the valley of two adjacent peaks must be greater than or equal to 60.0 percent of the height of the shorter peak.

The breakdown of DDT and Endrin in both of the PEMs must be less than 20.0 percent and the combined breakdown of DDT and Endrin must be less than 30.0 percent. All peaks in both the Performance Evaluation Mixtures must be 100 percent resolved on both columns.

The absolute retention times of each of the single component pesticides and surrogates in both of the PEMs must be within the retention time windows determined from the three point initial calibration.

The relative percent difference of the calculated amount and the true amount for each of the single component pesticides and surrogates in both of the PEMs must be less than or equivalent to 25 percent.

At least one chromatogram between any two adjacent peaks in the midpoint concentrations of Individual Standard Mixtures A and B in the initial calibration must be greater than or equal to 90 percent.

#### **7.2.4 System Calibration Procedure for Metals Analysis**

This section outlines the requirements for the calibration of atomic absorption (AA) and Inductively Coupled Plasma (ICP) systems for the determination of metals. The following will be performed in support of these requirements:

- Documentation of standard response
- Correlation coefficient monitoring

The AA system utilized for direct aspiration technique analysis will be initially calibrated with a calibration blank and five calibration standards. The standard concentrations will be determined as follows. One standard will be at a concentration near, but above, the Method Detection Limit (MDL). The other concentrations will correspond to the expected range of concentrations found in the actual samples. This five-point calibration must be performed daily.

The AA system utilized for graphite furnace technique analysis will be initially calibrated with a calibration blank and three calibration standards. The standard concentrations will be determined as follows. One standard will be at a concentration at the Contract Required Detection Limit (CRDL). The other concentrations will correspond to the expected range of concentrations found in the actual samples. This three-point calibration must be performed daily.

For AA systems, the calibration standards will be prepared fresh each time an analysis is to be performed and discarded after use. The standards contain the same reagents at the same concentrations as will result in the samples following preparation.

The ICP system will be calibrated initially with a calibration blank and one calibration standard. This calibration must be performed daily. In addition, ICP systems must undergo quarterly linearity checks.

#### Correlation Coefficient Calculation

The data points of the blank and the five calibration standards will be utilized to calculate the slope, the intercept, and the correlation coefficient of the best-fit line. An acceptable correlation coefficient must be achieved before sample analysis may begin. An acceptable correlation coefficient will be  $>0.995$  for AA analyses and  $>0.995$  for ICP analysis.

#### Calibration Verification

The initial calibration curve will be verified on each working day by the measurement of one mid-range calibration standard. The calibration verification acceptance criterion will be as follows:

- ICEP/GFAA - 90 to 110 percent of true value
- Cold Vapor AA - 80 to 120 percent of true value

When measurements exceed the control limits, the analysis will be terminated, the problem corrected, the instrument recalibrated, and the calibration reverified.

### **7.2.5 System Calibration Procedure for Inorganic Analyses**

This section outlines the requirements that will be used for calibration of calorimetric systems for analyses of inorganic parameters. The following will be performed in support of these requirements:

- Documentation of standard response
- Correlation coefficient monitoring

The system will be initially calibrated with a blank and five calibration standards. Standard concentrations will be at a concentration near, but above, the MDL with additional concentrations corresponding to the expected range of concentrations found in actual samples. Standards contain the same reagents at the same concentrations as will be present in samples following preparation.

#### Correlation Coefficient Calculation

Data points of the blank and five calibration standards will be utilized to calculate slope, intercept, and correlation coefficient of a best-fit line. An acceptable correlation coefficient must

be achieved before sample analysis may begin. An acceptable correlation coefficient will be  $>0.995$  for all systems.

#### Calibration Verification

The initial calibration curve will be verified on each working day by the measurement of two calibration standards.

- ICEP/GFAA - 90 to 110 percent of true value
- Cold Vapor AA - 80 - 120 percent of true value

When measurements exceed control limits, analysis will be terminated, the problem will be corrected, the instrument will be recalibrated, and calibration will be reverified.

#### **7.2.6 Periodic Calibration**

Periodic calibration must be performed on equipment required in analyses but not routinely calibrated as part of the analytical methodology. Equipment that falls within this category includes ovens, refrigerators, and balances. The calibration will be recorded either on specified forms or in bound notebooks. The calibration performed, and the frequency at which the calibration must be performed are discussed below.

- Balances will be calibrated weekly with class S weights.
- The pH meter will be calibrated daily with pH 4 and 7 buffer solutions and checked with pH 10 buffer solution.
- The temperatures of the refrigerators will be recorded daily.
- All liquid in glass thermometers will be calibrated annually with the N.B.S. certified thermometer. Dial thermometers will be calibrated quarterly.
- The N.B.S. Certified Thermometer will be checked annually at the ice point.

The following equipment must maintain the following temperatures:

- Sample Storage and Refrigerators - within 2 degrees of 4 degrees Celsius
- Water Bath, Mercury - within 2 degrees of 95 degrees Celsius

## **8.0 ANALYTICAL PROCEDURES**

The subsections that follow present analytical procedures.

### **8.1 Field Analysis**

An HNu PI-101 meter, used to detect total organic vapors, will be used to analyze ambient air for health and safety monitoring, as well as to screen soil during the soil sampling. An O<sub>2</sub>/LEL meter measures the oxygen content in the work atmosphere, as well as concentrations of combustible gases relative to explosive limits. This meter will be used for health and safety monitoring. Both the HNu and O<sub>2</sub>/LEL instruments will be operated in accordance with the manufacturer's instructions.

The pH, temperature, and specific conductivity of aqueous samples also will be measured in the field. These analyses will be obtained in accordance with "Handbook for Sampling and Sample Preservation of Water and Wastewater," September 1982, EPA/600/4-82-029.

### **8.2 Laboratory Analysis**

The samples that will be collected during the investigation and performed by the fixed-base laboratory will be analyzed for constituents listed in Tables 8-1 through 8-4. Parameters will be analyzed using USEPA methods (with corresponding method performance limits) as noted in Tables 8-1 through 8-4.

## **9.0 DATA REDUCTION, VALIDATION, AND REPORTING**

The subsections that follow present data reduction, validation, and reporting procedures.

### **9.1 Field Data Procedures**

Data validation practices will be followed as described by:

- "Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses," USEPA, June 1988.
- "Laboratory Data Validation Functional Guidelines for Evaluating Organic Analyses - Draft," USEPA, June 1991

The purpose of these practices is to insure that raw data are not altered and that an audit trail is developed for those data that require reduction. The documentation of sample collection will include the use of bound field logbooks in which all information on sample collection will be entered in indelible ink. Appropriate information will be entered to reconstruct the sampling event, including site name (top of each page), sample identification, brief description of sample, date and time of collection, sampling methodology, field measurements and observations, and sampler's initials (bottom of each page, and dated).

A rigorous data control program will insure that all documents for the investigations are accounted for when they are completed. Accountable documents include items such as log books, field data records, correspondence, COC records, analytical reports, data packages, photographs, computer disks, and reports. The Project Manager will be responsible for maintaining a project file in which all accountable documents will be inventoried. The project records will be retained for a period of three years after project closeout; then the files will be forwarded to the Navy.

All the field data, such as those generated during field measurements, observations, and field instrument calibrations, will be entered directly into a bound field notebook. Each project team member will be responsible for proofing all data transfers made and the Project Manager or his designee will proof at least ten percent of all data transfers.

### **9.2 Laboratory Data Procedures**

The following procedures summarize the practices routinely used by laboratory staff for data reduction, validation, and reporting. Numerical analyses, including manual calculations, will be documented and subjected to quality control review. Records of numerical analyses must be legible and complete enough to permit reconstruction of the work by a qualified individual other than the originator.

#### **9.2.1 Laboratory Data Validation**

Data validation begins with data reduction and continues through to the reporting of data.

Data processing will be checked by an individual other than the analyst who performed the data processing. The checker will review the data for the following:

- Utilization of the proper equations
- Correctness of numerical input

- Correctness of computations
- Correct interpretation of raw data (chromatographs, strip charts, etc.)

The checking process will be thorough enough to verify the results.

All entries made in bench books, data sheets, computation sheets, input sheets, etc. will be made in ink. No entry will be rendered unreadable.

### **9.2.2 Analytical Reports**

The items listed below will be required of analytical reports.

- Data will be presented in a tabular format.
- Analytical reports will be approved by appropriate laboratory personnel.
- The following information will be included on the report: client name and address, report date, sample date, analysis dates, number of samples, purchase order number, project number, and project type. All pages must be numbered.
- The sample numbers and corresponding laboratory numbers will be identified.
- The parameters analyzed, report units, and values will be identified.
- Method, trip, and field blank results will be reported.
- Matrix spike, matrix spike duplicate, and replicate recoveries will be reported.
- Calibration summaries will be reported.
- Surrogate recoveries will be reported.
- Holding times and sample analysis dates will be reported.
- The detection limit of the procedure will be identified.
- Consistent significant figures will be used.
- Referenced footnotes will be used when applicable.
- A letter of transmittal will accompany the report if any anomalies are associated with the data.

### **9.3 Independent (Third Party) Data Validation**

Review of all pertinent analytical data will be performed by Baker personnel and an independent third party data validator.

A preliminary review will be performed by the Project Manager or designee to verify that all-necessary paperwork (e.g., COC forms, traffic reports, analytical reports, and laboratory personnel signatures) and deliverables are present. A detailed and independent data validation

will be performed by a data validation subcontractor to verify the qualitative and quantitative reliability of the data presented and adherence to stated analytical protocols. This review will include a detailed review and interpretation of all data generated by the laboratory for Level IV deliverables. The primary tools that will be used by experienced data validation personnel will be analytical method operating practices, statements of work (for Contract Laboratory Program [CLP]), guidance documents, established criteria, and professional judgment.

During the data review, a data support documentation package will be prepared which will provide the back-up information that will accompany all qualifying statements present in the quality assurance review.

CLP data will be validated per the CLP criteria as outlined in the following documents:

- USEPA, Hazardous Site Control Division, Laboratory Data Validation Functional Guidelines for Evaluating Organics Analyses, 1994.
- USEPA, Hazardous Site Evaluation Division, Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses, 1994.

All other data will be validated in accordance with method of analysis using the National Functional Guidelines as a reference.

## **10.0 INTERNAL QUALITY CONTROL CHECKS**

The following section describes internal quality control checks.

### **10.1 Field Quality Control Checks**

Four types of field QA/QC samples will be submitted to the laboratory, including trip blanks, equipment rinsates, field blanks, and field duplicates. The results from the field quality control samples will be used by the data validator to determine the overall quality of the data. A breakdown by type of sample with which the QA/QC samples will be submitted to the laboratories is given in Table 10-1. Summaries of the number of environmental and QA/QC samples to be submitted for analysis are provided in the Work Plans.

#### **Field Blanks**

Field blanks consist of the source water used in decontamination, steam cleaning, and drilling. At a minimum, one field blank from each event and each source of water will be collected and analyzed for the same parameters as the related samples. Organic-free deionized water is taken to the field in sealed containers and poured into the appropriate sample containers at predesignated locations. This will be done to determine if any contaminants present in the area may have an affect on the sample integrity.

#### **Trip Blank**

Analysis of trip blanks will be performed to monitor possible contamination during shipment and collection of samples. Trip blanks are initiated in the laboratory prior to the shipping of sample packs. A corresponding trip blank will be prepared for each set of samples to be analyzed for volatile organic compounds (VOCs).

Trip blank samples will be prepared by the laboratory by adding four drops of concentrated hydrochloric acid and then filling the container with organic-free deionized water. The trip blanks accompany the samples through shipment to the sample site, sample collection, shipment to the laboratory, and storage of the samples.

If the analyses indicate contamination of the trip blank, the sample sources may be resampled. If the extent and nature of the contamination does not warrant such actions, the data will be accepted as valid.

#### **Field Duplicates**

Duplicate soil samples will be collected, homogenized, and split. Samples analyzed for parameters other than VOCs will be homogenized, and split. Samples for VOC analyses will not be mixed, but select segments of the soil will be collected from the length of the core by the Encore™ Sampler. Cores may be sealed and shipped to the laboratory for subsampling if deemed appropriate. Duplicate water samples will be collected simultaneously. Field duplicates will be collected at a frequency of 10% per sample matrix for Levels III and IV data. The duplicate samples will be sent to the primary laboratory responsible for analysis. The same samples used for field duplicates shall be split by the laboratory and used by the laboratory as the laboratory duplicate or matrix spike. This means that for the duplicate sample, there will be analyses of the normal sample, the field duplicate, and the laboratory matrix spike/duplicate.

## **Equipment Rinsates**

Equipment rinsates are the final organic-free deionized water rinse from equipment cleaning collected during a sampling event. The results of the blanks will be used to flag or assess levels of analytes in the samples. This comparison is made during validation. The rinsates are analyzed for the same parameters as the related samples.

## **10.2 Laboratory Quality Control Checks**

This section provides descriptions of the laboratory quality control checks.

### **Method Blank**

Analysis of method blanks will be performed to verify that method interferences caused by contamination in reagents, glassware, solvents, etc. are minimized and known.

Method blanks will be initiated by the analyst prior to the preparation, and/or analysis of the sample set. A method blank consists of a volume of organic-free deionized water equal to the sample volume that is carried through the entire analytical procedure. For solid samples to be analyzed by GC/MS, the method blank consists of a purified solid matrix approximately equal to the sample weight. A method blank will be analyzed with each set of samples or at the very least, daily. If the analytical data of the method blank indicates excessive contamination, the source of contaminant will be determined. The samples may be re-analyzed or the data may be processed "as is" depending upon the nature and extent of the contamination.

### **Replicate Sample Analysis**

Replicate sample analysis will be performed to demonstrate the precision of an analysis. An inter-laboratory replicate sample is initiated by the analyst prior to sample preparation and carried through the entire analytical procedure. The frequency of inter-laboratory replicate analysis for each analyte is summarized in Table 10-2.

### **Spike Analysis**

Spike analysis will be performed to demonstrate the accuracy of an analysis. The analyst initiates the spike prior to sample preparation and analysis by adding a known amount of analyte(s) to a sample. The spike sample is carried through the entire analytical procedure. The frequency of spike analysis for each analyte(s) is summarized in Table 10-2.

### **Surrogate Standards**

Surrogate standard analysis will be performed to monitor the preparation and analyses of samples. All samples and blanks analyzed by GC/MS and GC are fortified with a surrogate spiking solution prior to extraction or purging.

### **Internal Standards**

Internal standard analyses will be performed to monitor system stability. Prior to injection or purging, internal standards are added to all blanks and samples analyzed by GC/MS.

## **Matrix Spikes and Matrix Spike Duplicates**

A matrix spike is an aliquot of a matrix (water or soil) fortified (spiked) with known quantities of specific compounds and subjected to the entire analytical procedure in order to indicate the appropriateness of the method for the matrix by measuring recovery. A matrix spike duplicate is a second aliquot of the same matrix as the matrix spike that is spiked in order to determine the precision of the method. A matrix spike and matrix spike duplicate will be performed at a frequency of 1 per 20 samples for organics.

### **10.3 Laboratory Control Limits**

Control limits will be established for QC checks (spikes, duplicates, blanks, etc.). CLP control limits for surrogate standards spikes, and duplicates associated with GC/MS analyses and pesticides/PCB analyses will be applied. Control limits for spikes, duplicates, and reference samples will be determined internally through statistical analysis.

Whenever an out-of-control situation occurs, the cause is determined. Any needed corrective actions must be taken.

#### **Method Blanks**

For metals analyses, the criteria below are used for method blank analysis:

- If the concentration of the method blank is less than or equal to the detection level, no correction of sample results is performed.
- If the concentration of the blank is above the detection level for any group of samples associated with a particular blank, the concentration of the sample with the least concentrated analyte must be ten times the blank concentration. Otherwise, all samples associated with the blank and less than ten times the blank concentration must be redigested (reprepared) and reanalyzed, if possible. If the affected samples cannot be reprepared and reanalyzed within method holding times, the flagged sample result and the blank result are both to be reported. The sample value is not corrected for the blank value.

For GC/MS, GC analyses, the criteria below are used for method blank analysis:

- A method blank for volatile organic analysis must contain no greater than five times the detection limit of common laboratory solvents (common laboratory solvents are: methylene chloride, acetone, toluene, 2-butanone, and chloroform).
- A method blank for semivolatile organics analysis must contain no greater than five times the detection limit of common phthalate esters.
- For all other compounds not listed above, the method blank must contain less than the detection limit of any single compound. If a method blank exceeds the criteria, the analytical system is considered to be out of control. The source of the contamination is investigated and appropriate corrective measures are taken and documented before sample analysis proceeds. All samples processed with a method blank that is out of control (i.e., contaminated), are reextracted/repurged and reanalyzed, when possible. If the affected samples cannot be reextracted/repurged and reanalyzed within method holding times, the flagged sample result and the blank result are both to be reported. The sample value is not corrected for the blank value.

- No positive result for pesticides/PCBs should be reported unless the concentration of the compound exceeds five times the amount in the blank.
- A method blank for pesticides/PCBs must contain no greater than five times the detection limit for any pesticides/PCBs.

### **Surrogate Standards**

For method blank surrogate standard analysis, corrective action will be taken if any one of the conditions below exist:

- Recovery of any one surrogate compound in the volatile fraction is outside the required surrogate standard recovery limit.
- Recovery of any one surrogate compound in the semivolatile fraction is outside surrogate standard recovery limits.

Corrective action will include steps listed below:

- A check of: the calculations for errors; the internal standard and surrogate spiking solutions for degradation, contamination, etc.; and instrument performance.
- Recalculation or reinjection/repurging of the blank or extract if the above corrective actions fail to solve the problem.
- Reextraction and reanalysis of the blank. For sample surrogate standard analysis, corrective action will be taken if any one of the following conditions exist:
  - ▶ Recovery of any one surrogate compound in the volatile fraction is outside the surrogate spike recovery limits;
  - ▶ Recovery of any one surrogate compound in either semivolatile fraction is below ten percent; or
  - ▶ Recoveries of two or more surrogate compounds in either semivolatile fraction are outside surrogate spike recovery limits.

Corrective action will include the steps listed below.

- A check of: the calculations for errors; of the internal standard and surrogate spiking solutions for degradation, contamination, etc.; and of instrument performance.
- Recalculating or reanalysis the sample or extract if the above corrective action fails to solve the problem.
- Reextraction and reanalysis of the sample if none of the above are a problem.

## **11.0 PREVENTIVE MAINTENANCE**

The following section outlines preventative maintenance.

### **11.1 Field Maintenance**

The HNu PI-101 meter is to be used in site characterization and will be maintained as described by the manufacturer's instructions. The pH and specific conductance meters to be used during sampling will be maintained according to Baker's Standard Operating Procedure (SOP) F201. A full set of SOPs will be maintained in the field trailer.

### **11.2 Laboratory Maintenance**

Preventive maintenance is an organized program of actions to prevent instruments and equipment from failing during use and to maintain proper performance of equipment and instruments. A comprehensive preventive maintenance program is implemented to increase the reliability of the measurement system. The preventive maintenance program will address the following:

- Schedules of important preventive maintenance tasks that are carried out to minimize downtime.
- Lists of critical spare parts that are available to minimize downtime.

The laboratory maintains histories, in instrument/equipment logs, of all major equipment. Troubleshooting, maintenance, and spare parts inventory will be recorded in the logs. Instruments and equipment will be maintained periodically in accordance with procedures described in individual analytical methods, manufacturer's recommendation, and/or service contracts.

The modern analytical laboratory depends heavily upon instrumentation and equipment; therefore, cleaning and preventive maintenance are primary considerations in the sustained production of satisfactory data. Specific requirements for proper care of laboratory instrumentation and equipment are contained in the manufacturer's instructions; however, some general guidelines are considered, and are listed below.

- Special precautions must be taken to avoid spillage of corrosive chemicals on or around equipment and instrumentation not only to extend the life of the item, but also to eliminate contamination.
- Where available, covers must be placed on instrumentation when not in use.
- Instrument parts must be cleaned as required (i.e., mirrors, probes, detector cells).

## **12.0 DATA MEASUREMENT ASSESSMENT PROCEDURES**

The subsections that follow outline data measurement assessment procedures.

### **12.1 Overall Project Assessment**

Overall data quality will be assessed by a thorough understanding of the data quality objectives. By maintaining thorough documentation of all decisions made during each phase of sampling, performing field and laboratory audits, thoroughly reviewing the analytical data as they are generated by the laboratory, and providing appropriate feedback as problems arise in the field or at the laboratory, data accuracy, precision, and completeness will be closely monitored.

### **12.2 Field Quality Assessment**

To assure that all field data are collected accurately and correctly, specific written instructions will be issued to all personnel involved in field data acquisition by the Project Manager. The evaluation (data review) of field blanks, and other field QC samples will provide definitive indications of the data quality. If a problem that can be isolated arises, corrective actions can be instituted for future field efforts.

### **12.3 Laboratory Data Quality Assessment**

As part of the analytical QA/QC program, the laboratory applies precision and accuracy criteria for each parameter that is analyzed. When analysis of a sample set is completed, QC data generated will be reviewed and evaluated to ensure acceptance criteria are met. These criteria will be method and matrix specific.

QA/QC data review is based on the following criteria:

- **Method Blank Evaluation** - The method blank results will be evaluated for high readings characteristic of background contamination. If high blank values are observed, laboratory glassware and reagents are checked for contamination and the analysis of future samples halted until the system can be brought under control. A high background is defined as a background value sufficient to result in a difference in the sample values, if not corrected, greater than or equal to the smallest significant digit known to be valid. A method blank must contain no greater than two times the parameter detection limit for most parameters.
- **Trip Blank Evaluation** - Trip blank results will be evaluated for high readings similar to the method blanks described above. If high trip blank readings are encountered (i.e. a value sufficient to result in a difference in sample values, if not corrected, greater than or equal to the smallest significant digit known to be valid), procedures for sample collection, shipment, and laboratory analysis are reviewed. If both the method and the trip blanks exhibit significant background contamination, the source of contamination is probably within the laboratory. Ambient air in the laboratory and reagents will be checked as possible sources of contamination.
- **Standard Calibration Curve Verification** - The calibration curve or midpoint calibration standard (check standard) will be evaluated daily to determine curve linearity through its full range and that sample values are within the range defined by the low and high standards. If the curve is not linear, sample values are corrected. If average response factors are used to calculate sample concentrations, these factors are verified on a daily basis. Verification of calibration curves and response factors will be accomplished when the evaluated response for

any parameter varies from the calibrated response by less than ranges specified in Section 7.0.

- Duplicate Sample Analyses - Duplicate sample analyses will be used to determine the precision of the analytical method for the sample matrix. Two types of duplicate samples will be analyzed for this project, field, and laboratory. Duplicate results will be used to calculate precision as defined by the relative percent difference (RPD). If laboratory duplicate values exceed the control limit, the sample set may be reanalyzed for the parameter in question. Precision limits will be updated periodically following review of data.
- Reference Sample Analyses - The results of reference sample analysis will be compared with true values, and the percent recovery of the reference sample will be calculated. If correction is required (excessive or inadequate percent recovery), the reference sample must be reanalyzed to demonstrate that the corrective action has been successful.
- Surrogate Standard Analyses - Surrogate standard determinations will be performed on all samples and blanks for GC/MS analyses. All samples and blanks are fortified with surrogate spiking compounds before purging or extraction to monitor preparation and analysis of samples. Recoveries must meet specific criteria. If acceptance criteria are not met, corrective action must be taken to correct the problem and the affected sample must be reanalyzed.
- Matrix Spike Analyses - The observed recovery of spike versus theoretical spike recovery will be used to calculate accuracy as defined by the percent recovery. If the accuracy value exceeds the control limit for the given parameter, the appropriate laboratory personnel notified and corrective action will be taken before the sample set is reanalyzed for the parameter in question.

For completeness, it is expected that the methodology proposed for chemical characterization of the samples will meet QC acceptance criteria for at least 95 percent of all sample data. To ensure this completeness goal, data that does not meet the acceptance criteria will be recollected, reextracted, or reanalyzed, if necessary.

Data representativeness will be ensured through the use of appropriate analytical procedures, and analysis performed within the allowed holding times. Comparability is a qualitative characteristic of the data. By using standard methods for sampling and analyses, data generated in past or future investigations will be comparable with this investigation data.

### **13.0 CORRECTIVE ACTION**

Corrective action will be taken whenever a nonconformance occurs. A nonconformance will be defined as an event that is beyond the limits established for a particular operation by the plan. Nonconformances can occur in a number of activities. Such activities include sampling procedures, sample receipt, sample storage, sample analysis, data reporting, and computations.

The following personnel will be responsible for detecting and reporting nonconformances:

- Project Staff - during testing and preparation and verification of numerical analyses.
- Laboratory Staff - during the preparation for analyses, performance of analytical procedures, calibration of equipment, and quality control activities.

#### **13.1 Limits of Operation**

The limits of operation that are used to identify nonconformances will be established by the contents of the Work Plans and QAPP. Inter-laboratory control limits produced by statistical analyses will also be considered as limits of operation.

#### **13.2 Corrective Action**

Nonconformances will be identified and communicated to Baker to avoid delays with respect to project schedules and prevent the submission of non-valid data. Documentation will include the following:

- Personnel identifying the nonconformance(s) will be identified.
- The nonconformance(s) will be described and communicated to the Baker Project Manager.
- For serious nonconformances, the Site Supervisor will have the authority to initiate corrective action.
- For less serious nonconformances, corrective action will be decided upon and signatures will be obtained prior to implementation of corrective action.
- All nonconformances and corrective actions will be documented and reside with the Baker Activity Coordinator. This documentation will be available to CH2M Hill and the DoN, Atlantic Division (LANTDIV).

The Baker Project Manager will be notified of laboratory or field nonconformances and corrective actions taken if:

- A nonconformance causes a delay in work beyond the schedule completion date.
- A nonconformance affects information already reported.
- A nonconformance affects the validity of the data.

If the nonconformance(s) are serious and corrective action cannot resolve the problem(s), NFESC Contract Representatives (NCRs) and the LANTDIV Navy Technical Representative (NTR) may be notified by Baker.

#### **14.0 QUALITY ASSURANCE REPORTING PROCEDURES**

The Project Manager will be responsible for assessing the performance of measurement systems and data quality related to the field investigation. A written record will be maintained of: the results of laboratory QC reports and other periodic assessments of measurement, data accuracy, precision, and completeness; performance and system audits; and any significant QA problems and recommended solutions. Each deliverable will contain a QA/QC assessment section. Also, a QA/QC assessment will be performed any time a significant problem is identified.

The Project Manager will keep in contact with CH2M Hill and the LANTDIV NTR through informal, verbal reports during the project as well as through monthly progress reports.

## **TABLES**

TABLE 5-1

DEFINITIONS OF DATA QUALITY INDICATORS  
PHASE II CONFIRMATORY SAMPLING INVESTIGATION, CTO-0143  
MCB CAMP LEJEUNE, NORTH CAROLINA

**PRECISION** - A measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. Precision is expressed in terms of the standard deviation. Comparison of replicate values is best expressed as the relative percent difference (RPD). Various measures of precision exist depending upon the "prescribed similar conditions".

**ACCURACY** - The degree of agreement of a measurement (or an average of replicate measurements),  $X$ , with an accepted reference or true value,  $T$ , expressed as the difference between the two values,  $X-T$ . Accuracy is a measure of the bias in a system.

**REPRESENTATIVENESS** - Expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental concern.

**COMPLETENESS** - A measure of the amount of the valid data obtained from the measurement system compared to the amount that was expected under "normal" conditions.

**COMPARABILITY** - Expresses the confidence with which one data set can be compared with another.

**UNCERTAINTY** - The likelihood of all types of errors associated with a particular decision.

TABLE 6-1

**SUMMARY OF CONTAINERS, PRESERVATION, AND HOLDING TIMES FOR AQUEOUS SAMPLES  
PHASE II CONFIRMATORY SAMPLING INVESTIGATION, CTO-0143  
MCB CAMP LEJEUNE, NORTH CAROLINA**

Parameter	Container	Preservation	Holding Time
TCL Volatiles - EPA Methods 8240 and/or 8020	Two 40-mL vials with teflon septum caps	Cool, 4°C HCl pH <2	14 days (7 days if unpreserved)
TCL Semivolatiles - EPA Method 8270	1-liter amber glass bottle with teflon caps	Cool, 4°C	7 days to extraction; 40 days from extraction to analysis
TCL Pesticides/PCBs - EPA Method 8080	1-liter amber glass bottle with teflon caps	Cool, 4°C	7 days to extraction; 40 days after extraction for analysis
TAL Metals	1-500 ml polyethylene bottle	HNO <sub>3</sub> pH<2	6 months; Mercury 28 days

Notes:

TAL - Target Analyte List

TCL - Target Contaminant List

TABLE 6-2

**SUMMARY OF CONTAINERS, PRESERVATION, AND HOLDING TIMES FOR SOLID SAMPLES  
PHASE II CONFIRMATORY SAMPLING INVESTIGATION, CTO-0143  
MCB CAMP LEJEUNE, NORTH CAROLINA**

Parameter	Container	Preservation	Holding Time
TCL Volatiles - EPA Methods 8240 and/or 8020	Two ENCORE Samplers	Cool, 4°C	10 days
TCL Semivolatiles - EPA Method 8270	One 8-ounce wide-mouth glass jar	Cool, 4°C	7 days to extraction; 40 days from extraction to analysis
TCL Pesticides/PCBs - EPA Method 8080	One 8-ounce wide-mouth glass jar	Cool, 4°C	7 days to extraction; 40 days after extraction for analysis
TAL Metals	One 8-ounce wide-mouth glass jar	Cool, 4°C	6 months; Mercury, 28 days
Corrosivity	One 4-ounce wide-mouth glass jar	Cool, 4°C	10 days
Ignitability	One 4-ounce wide-mouth glass jar	Cool, 4°C	14 days
Reactivity	One 4-ounce wide-mouth glass jar	Cool, 4°C	10 days

Notes:

TAL - Target Analyte List

TCL - Target Contaminant List

TCLP - Toxicity Characteristic Leaching Procedure

TABLE 8-1

**METHOD PERFORMANCE LIMITS**  
**PHASE II CONFIRMATORY SAMPLING INVESTIGATION, CTO-0143**  
**MCB CAMP LEJEUNE, NORTH CAROLINA**

Compound	Water PQL (µg/L)	Soil/Sediment PQL (µg/kg)	Method
<b>Volatiles</b>			Method 8240
Benzene	20	20	
Chlorobenzene	20	20	
1,4-Dichlorobenzene	30	30	
1,3-Dichlorobenzene	40	40	
1,2-Dichlorobenzene	40	40	
Ethyl Benzene	20	20	
Toluene	20	20	
Chloromethane	10	10	
Bromomethane	10	10	
Vinyl Chloride	10	10	
Chloroethane	10	10	
Methylene Chloride	5	5	
Acetone	100	100	
Carbon Disulfide	5	5	
1,1 -Dichloroethene	5	5	
1,1 -Dichloroethane	5	5	
1,2 -Dichloroethene	5	5	
Chloroform	5	5	
1,2 -Dichloroethane	5	5	
2-Butanone	100	100	
1,1,1-Trichloroethane	5	5	
Carbon Tetrachloride	5	5	
Vinyl Acetate	50	50	
Bromodichloromethane	5	5	
1,1,2,2-Tetrachloroethane	5	5	
1,2-Dichloropropane	5	5	
trans-1,3-Dichloropropene	5	5	
Trichloroethene	5	5	
Dibromochloromethane	5	5	
1,1,2-Trichloroethane	5	5	
Benzene	5	5	
cis-1,3-Dichloropropene	5	5	
2-Chloroethyl Vinyl Ether	10	10	
Bromofrom	5	5	

TABLE 8-1 (Continued)

**METHOD PERFORMANCE LIMITS**  
**PHASE II CONFIRMATORY SAMPLING INVESTIGATION, CTO-0143**  
**MCB CAMP LEJEUNE, NORTH CAROLINA**

Compound	Water PQL (µg/L)	Soil/Sediment PQL (µg/kg)	Method
<b>Volatiles (continued):</b>			Method 8240
2-Hexanone	50	50	
4-Methyl-2-pentanone	50	50	
Tetrachloroethene	5	5	
Toluene	5	5	
Chlorobenzene	5	5	
Ethyl Benzene	5	5	
Styrene	5	5	
Total Xylenes	5	5	
<b>Semivolatiles</b>			Method 8270
Phenol	10	660	
bis(2-Chloroethyl)ether	10	660	
2-Chlorophenol	10	660	
1,3-Dichlorobenzene	10	660	
1,4-Dichlorobenzene	10	660	
Benzyl alcohol	20	1300	
1,2-Dichlorobenzene	10	660	
2-Methylphenol	10	660	
bis(2-Chloroisopropyl)ether	10	660	
4-Methylphenol	10	660	
N-Nitroso-di-n-dipropylamine	10	660	
Hexachloroethane	10	660	
Nitrobenzene	10	660	
Isophorone	10	660	
2-Nitrophenol	10	660	
2,4-Dimethylphenol	10	660	
Benzoic acid	50	3,300	
bis(2-Chloroethoxyl)methane	10	660	
2,4-Dichlorophenol	10	660	
1,2,4-Trichlorobenzene	10	660	
Naphthalene	10	660	
4-Chloroaniline	20	1,300	
Hexachlorobutadiene	10	660	

TABLE 8-1 (Continued)

**METHOD PERFORMANCE LIMITS**  
**PHASE II CONFIRMATORY SAMPLING INVESTIGATION, CTO-0143**  
**MCB CAMP LEJEUNE, NORTH CAROLINA**

Compound	Water PQL (µg/L)	Soil/Sediment PQL (µg/kg)	Method
<b>Semivolatiles (continued)</b>			Method 8270
4-Chloro-3-methylphenol (para-chloro-meta-cresol)	20	1,300	
2-Methylnaphthalene	10	660	
Hexachlorocyclopentadiene	10	660	
2,4,6-Trichlorophenol	10	660	
2,4,5-Trichlorophenol	10	660	
2-Chloronaphthalene	10	660	
2-Nitroaniline	50	3,300	
Dimethylphthalate	10	660	
Acenaphthylene	10	660	
Acenaphthene	10	660	
2,4-Dinitrophenol	50	3300	
4-Nitrophenol	50	3300	
Dibenzofuran	10	660	
2,4-Dinitrotoluene	10	660	
2,6-Dinitrotoluene	10	660	
Diethylphthalate	10	660	
4-Chlorophenyl phenyl ether	10	660	
Fluorene	10	660	
4-Nitroaniline	50	3300	
4,6-Dinitro-2-methylphenol	50	3300	
N-Nitrosodiphenylamine	10	660	
4-Bromophenyl phenyl ether	10	660	
Hexachlorobenzene	10	660	
Pentachlorophenol	50	3300	
Phenanthrene	10	660	
Anthracene	10	660	
Di-n-butylphthalate	10	660	
Fluoranthene	10	660	
Pyrene	10	660	
Butyl benzyl phthalate	10	660	
3,3'-Dichlorobenzidine	20	1300	
Benzo(a)anthracene	10	660	

TABLE 8-1 (Continued)

**METHOD PERFORMANCE LIMITS**  
**PHASE II CONFIRMATORY SAMPLING INVESTIGATION, CTO-0143**  
**MCB CAMP LEJEUNE, NORTH CAROLINA**

Compound	Water PQL (µg/L)	Soil/Sediment PQL (µg/kg)	Method
<b>Semivolatiles (continued)</b>			Method 8270
bis(2-ethylhexyl)phthalate	10	660	
Chrysene	10	660	
Di-n-octyl phthalate	10	660	
Benzo(b)fluoranthene	10	660	
Benzo(k)fluoranthene	10	660	
Benzo(a)pyrene	10	660	
Indeno(1,2,3-cd)pyrene	10	660	
Dibenz(a,h)anthracene	10	660	
Benzo(g,h,i)perylene	10	660	
<b>Pesticides/PCBs</b>			Method 8080
alpha-BHC	0.03	2.01	
beta-BHC	0.06	4.02	
delta-BHC	0.09	6.03	
gamma-BHC (Lindane)	0.04	2.68	
Heptachlor	0.03	2.01	
Aldrin	0.04	2.68	
Heptachlor epoxide	0.83	55.61	
Endosulfan I	0.14	9.38	
Dieldrin	0.02	1.34	
4,4'-DDE	0.11	7.37	
Endrin	0.06	4.02	
Endosulfan II	0.04	2.68	
4,4'-DDD	0.11	7.37	
Endosulfan sulfate	0.66	44.22	
4,4'-DDT	0.12	8.04	
Methoxychlor	1.76	117.92	
Endrin ketone	0.06	4.02	
Endrin aldehyde	0.23	15.41	
Chlordane (technical)	0.14	9.38	
Toxaphene	2.4	160.8	
Aroclor-1016	ND	ND	
Aroclor-1221	ND	ND	
Aroclor-1232	ND	ND	
Aroclor-1242	0.65	43.55	

TABLE 8-1 (Continued)

METHOD PERFORMANCE LIMITS  
PHASE II CONFIRMATORY SAMPLING INVESTIGATION, CTO-0143  
MCB CAMP LEJEUNE, NORTH CAROLINA

Compound	Water PQL (µg/L)	Soil/Sediment PQL (µg/kg)	Method
Pesticides/PCBs			
Aroclor-1248	ND	ND	Method 8080
Aroclor-1254	ND	ND	
Aroclor-1260	ND	ND	

Notes:

PQL = Practical Quantitation Limit

TABLE 8-2

**INORGANIC METHOD PERFORMANCE LIMITS  
PHASE II CONFIRMATORY SAMPLING INVESTIGATION, CTO-0143  
MCB CAMP LEJEUNE, NORTH CAROLINA**

Analyte	Method Number <sup>(2,3,4)</sup>	IDL <sup>(1)</sup> (µg/L)	Method Description
<b>Metals</b>			
Aluminum	7010		Atomic Absorption, Direct Aspiration
Antimony	70407041	203	Atomic Absorption, Direct Aspiration Atomic Absorption, Furnace Technique
Arsenic	70607061	12	Atomic Absorption, Furnace Technique Atomic Absorption, Direct Aspiration
Barium	7080		Atomic Absorption, Direct Aspiration
Beryllium	70907091	50.2	Atomic Absorption, Direct Aspiration Atomic Absorption, Furnace Technique
Cadmium	71307130	50.1	Atomic Absorption, Direct Aspiration Atomic Absorption, Furnace Technique
Calcium	7140	10	Atomic Absorption, Direct Aspiration
Chromium	71907191	10	Atomic Absorption, Direct Aspiration Atomic Absorption, Furnace Technique
Cobalt	72007201	501	Atomic Absorption, Direct Aspiration Atomic Absorption, Furnace Technique
Copper	7210	20	Atomic Absorption, Direct Aspiration
Iron	7380	30	Atomic Absorption, Direct Aspiration
Lead	74207421	1001	Atomic Absorption, Direct Aspiration Atomic Absorption, Furnace Technique
Magnesium	7450	1	Atomic Absorption, Direct Aspiration
Manganese	7460	10	Atomic Absorption, Direct Aspiration
Mercury	74707471	0.2	Water by manual cold vapor technique Soil/sediment by manual cold vapor technique
Nickel	7520	40	Atomic Absorption, Direct Aspiration
Potassium	7610	10	Atomic Absorption, Direct Aspiration
Selenium	77407741	2	Atomic Absorption, Furnace Technique Atomic Absorption, Gaseous Hydride
Silver	7760	10	Atomic Absorption, Direct Aspiration
Sodium	7770	2	Atomic Absorption, Direct Aspiration
Thallium	78407841	1001	Atomic Absorption, Direct Aspiration Atomic Absorption, Furnace Technique
Vanadium	79107911	2004	Atomic Absorption, Direct Aspiration Atomic Absorption, Furnace Technique
Zinc	7950	5	Atomic Absorption, Direct Aspiration

Notes:

- <sup>(1)</sup> Methods taken from "Test Methods for Evaluating Solid Waste," USEPA SW846, November 1986, 3rd Edition.

IDL = Instrument Detection Limit

TABLE 8-3

**TCLP METHOD PERFORMANCE LIMITS  
PHASE II CONFIRMATORY SAMPLING INVESTIGATION, CTO-0143  
MCB CAMP LEJEUNE, NORTH CAROLINA**

Parameter	Aqueous PQL <sup>(1)</sup> (µg/l)	Solid PQL(1) (µg/kg)	Method
<b>TCLP Volatiles</b>	5	10	EPA Method 3550/ EPA Method 8240
Benzene			
Carbon Tetrachloride	5	5	
Chloroform	5	5	
1,2-Dichloroethane	5	5	
1,1-Dichloroethylene	5	5	
Methyl ethyl ketone	N/A	NA	
Tetrachloroethylene	5	5	
Trichloroethylene	5	5	
Vinyl Chloride	10	10	
<b>TCLP Semivolatiles</b>	10	660	EPA Method 3550/ EPA Method 8270
o-Cresol			
m-Cresol	10	660	
p-Cresol	10	660	
Cresol	10	660	
1,4-Dichlorobenzene	10	660	
2,4-Dinitrotoluene	10	660	
Hexachlorobenzene	10	660	
Hexachlorobutadiene	10	660	
Hexachloroethane	10	660	
Nitrobenzene	10	660	EPA Method 3550/ EPA Method 8240
Pentachlorophenol	50	3300	
Pyridine	50	660	
2,4,5-Trichlorophenol	10	660	
2,4,6-Trichlorophenol	10	660	
<b>TCLP Pesticides</b>	0.14	9.4	
Chlordane			
Endrin	0.06	4.0	
Heptachlor (and its hydroxide)	0.03	20	
Lindane	0.04	2.7	
Methoxychlor	1.8	120	EPA Method 8150
Toxaphene	2.4	160	
<b>TCLP Herbicides</b>	12	240	
2,4-D			EPA Method 8150
2,4,5-TP Silvex	1.7	34	

TABLE 8-3 (Continued)

**TCLP METHOD PERFORMANCE LIMITS**  
**PHASE II CONFIRMATORY SAMPLING INVESTIGATION, CTO-0143**  
**MCB CAMP LEJEUNE, NORTH CAROLINA**

Analyte	Aqueous PQL <sup>(1)</sup> (mg/L)	Soil PQL <sup>(1)</sup> (mg/kg)	Method	Method Description
<b>TCLP Metals</b>	10	30	6010	Inductively Coupled Plasma
Arsenic			7060	Atomic Absorption, Furnace Technique
Barium	20	1	6010	Inductively Coupled Plasma
Cadmium	1	2	6010	Inductively Coupled Plasma
			7131	Atomic Absorption, Furnace Technique
Chromium	20	4	6010	Inductively Coupled Plasma
			7191	Atomic Absorption, Furnace Technique
Lead	10	2	6010	Inductively Coupled Plasma
			7421	Atomic Absorption, Furnace Technique
Mercury	2	0.002	7470	Soil by manual cold vapor technique Soil by automated cold vapor technique
Selenium	20	40	6010	Inductively Coupled Plasma
			7740	Atomic Absorption, Furnace Technique
Silver	2	4	6010	Inductively Coupled Plasma
			7760	Atomic Absorption, Furnace Technique

Notes:

- <sup>(1)</sup> Practical Quantitation Limit, taken from "Test Methods for Evaluating Solid Waste," USEPA, November 1986.

Note: These methods will be used to analyze the Toxicity Characteristic Leaching Procedure (TCLP) extract. The extract will be prepared using Method 1311, described in "Hazardous Waste Management Systems; Identification and Listing of Hazardous Waste; Toxicity Characteristics revision; Final Rule," USEPA, 52FR 26886.

TABLE 8-4

**RCRA/ENGINEERING PARAMETER METHOD PERFORMANCE LIMITS  
PHASE II CONFIRMATORY SAMPLING INVESTIGATION, CTO-0143  
MCB CAMP LEJEUNE, NORTH CAROLINA**

Parameter	Aqueous Performance Limit	Solid Performance Limit	Method
<b>RCRA</b> pH/Corrosivity	N/A	N/A	SW-846 9010
Ignitability	N/A	N/A	SW-846 1010
Reactive Cyanide	10 mg/l <sup>(1)</sup>	10 mg/l	SW-846 9012
Reactive Sulfide	50 mg/l <sup>(1)</sup>	50 mg/kg <sup>(1)</sup>	SW-846 9030
<b>Engineering Parameters</b> Total Organic Carbon (TOC)	N/A	N/A	EPA 415.1
Grain Size	N/A	N/A	ASTM D 422-63
Cation Exchange Capacity (CEC)	N/A	N/A	EPA 9081
Total Suspended Solids (TSS)	N/A	N/A	ASTM 2540D
Total Dissolved Solids (TDS)	N/A	N/A	ASTM 2540C

Notes:

- <sup>(1)</sup> Performance Limit, taken from "Test Methods for Evaluating Solid Waste," USEPA, November 1986.

N/A - Not Applicable

TABLE 10-1

**QA/QC SAMPLE FREQUENCY**  
**PHASE II CONFIRMATORY SAMPLING INVESTIGATION, CTO-0143**  
**MCB CAMP LEJEUNE, NORTH CAROLINA**

Type of Sample	Metal	Organic
Trip Blank (for volatiles only)	NA <sup>(1)</sup>	One per cooler or one per shipping day
Equipment Rinsate <sup>(2)</sup>	One per day	One per day
Field Blank	One per source per event <sup>(3)</sup>	
Field Duplicate <sup>(4)</sup>	10%	10%

## Notes:

- (1) Not Applicable
- (2) Samples are collected daily per media; however, only samples from every other day are analyzed. Other samples are held and analyzed only if evidence of contamination exists.
- (3) Source water includes water used in decontamination, steam cleaning, and drilling.
- (4) The duplicate must be taken from the sample which will become the laboratory matrix spike/matrix spike duplicate for organics or for the sample used as a duplicate in inorganic analysis.

TABLE 10-2

**QC ANALYSIS FREQUENCY**  
**PHASE II CONFIRMATORY SAMPLING INVESTIGATION, CTO-0143**  
**MCB CAMP LEJEUNE, NORTH CAROLINA**

Parameter	Replicate	Spike
<b>Organic</b>		
All analyses by GC/MS	5%	5%
All analyses by GC	5%	5%
<b>Metals</b>		
Liquids by flame AA or ICP	5%	5%
Solids by flame AA or ICP	5%	10%
All analyses by furnace AA	5%	10%

## **FIGURES**

FIGURE 4-1

PROJECT TEAM ORGANIZATION  
QUALITY ASSURANCE PROJECT PLAN  
MCB, CAMP LEJEUNE, NORTH CAROLINA

